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(54) **SYSTEM, METHODS, APPARATUSES, AND COMPUTER PROGRAM PRODUCTS FOR DETECTING THAT AN OBJECT HAS BEEN ACCESSED**

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CPC .... **G06K 19/07798** (2013.01); **G06K 2017/009** (2013.01); **G06K 2017/0045** (2013.01); **G06K 2017/0064** (2013.01)

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,717,042 A	1/1988	McLaughlin
4,785,969 A	11/1988	McLaughlin
4,847,764 A	7/1989	Halvorson
5,003,296 A	3/1991	Lee
5,014,875 A	5/1991	McLaughlin et al.
5,190,185 A	3/1993	Blechl

5,314,243 A	5/1994	McDonald et al.
5,346,297 A	9/1994	Colson, Jr. et al.
5,377,864 A	1/1995	Blechl et al.
5,405,048 A	4/1995	Rogers et al.
5,431,299 A	7/1995	Brewer et al.
5,460,294 A	10/1995	Williams
5,468,110 A	11/1995	McDonald et al.
5,480,062 A	1/1996	Rogers et al.
5,520,450 A	5/1996	Colson, Jr. et al.
5,564,803 A	10/1996	McDonald et al.
5,593,267 A	1/1997	McDonald et al.

(Continued)

#### OTHER PUBLICATIONS

SP Central; "Pharmacy Management System & Workflow System;" ScriptPro®, Pharmacy Automation; www.scripto.com; Mar. 30, 2009 [http://www.scriptpro.com/products/SPC\\_PMS\\_Workflow\\_brochure\\_single\\_pgs.pdf](http://www.scriptpro.com/products/SPC_PMS_Workflow_brochure_single_pgs.pdf).

For Health Technologies, Inc.; "IntelliFill I.V.—Automates the Preparation of Small Volume I.V. Medication," <http://www.fhtinc.com/pharmacy.html>; Mar. 30, 2009.

(Continued)

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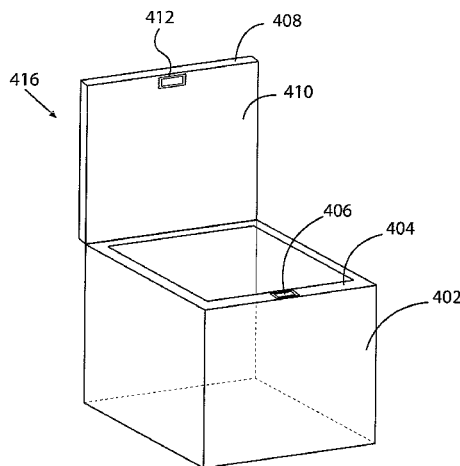
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(57)

#### ABSTRACT

A system, method, apparatus, and computer program product are provided for detecting that an object has been accessed. A system may include a first surface carrying a first signaling tag and a second surface carrying a second signaling tag. The first and second signaling tags may be positioned such that when the second surface is in a first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling between the first signaling tag and the second signaling tag results in a first signal state being emitted by at least one of the signaling tags. When the second surface is transitioned from the first position to a second position, a decoupling between the first signaling tag and the second signaling tag may in a second signal state being emitted by at least one of the signaling tags.

**23 Claims, 8 Drawing Sheets**



(56)

## References Cited

## U.S. PATENT DOCUMENTS

- |              |      |         |  |
|--------------|------|---------|--|
| 5,661,978    | A    | 9/1997  | Holmes et al.                            |
| D384,578     | S    | 10/1997 | Wangu et al.                             |
| 5,713,485    | A    | 2/1998  | Liff et al.                              |
| 5,716,114    | A    | 2/1998  | Holmes et al.                            |
| 5,745,366    | A    | 4/1998  | Higham et al.                            |
| 5,761,877    | A    | 6/1998  | Quandt                                   |
| 5,797,515    | A    | 8/1998  | Liff et al.                              |
| 5,805,456    | A    | 9/1998  | Higham et al.                            |
| 5,842,976    | A    | 12/1998 | Williamson                               |
| 5,878,885    | A    | 3/1999  | Wangu et al.                             |
| 5,880,443    | A    | 3/1999  | McDonald et al.                          |
| 5,883,806    | A    | 3/1999  | Meador et al.                            |
| 5,893,697    | A    | 4/1999  | Zini et al.                              |
| 5,905,653    | A    | 5/1999  | Higham et al.                            |
| 5,912,818    | A    | 6/1999  | McGrady et al.                           |
| 5,927,540    | A    | 7/1999  | Godlewski                                |
| 5,940,306    | A    | 8/1999  | Gardner et al.                           |
| 5,971,593    | A    | 10/1999 | McGrady                                  |
| 6,003,006    | A    | 12/1999 | Colella et al.                           |
| 6,011,999    | A    | 1/2000  | Holmes                                   |
| 6,021,392    | A    | 2/2000  | Lester et al.                            |
| 6,039,467    | A    | 3/2000  | Holmes                                   |
| 6,065,819    | A    | 5/2000  | Holmes et al.                            |
| 6,068,156    | A    | 5/2000  | Liff et al.                              |
| 6,109,774    | A    | 8/2000  | Holmes et al.                            |
| 6,112,502    | A    | 9/2000  | Frederick et al.                         |
| 6,116,461    | A    | 9/2000  | Broadfield et al.                        |
| 6,151,536    | A    | 11/2000 | Arnold et al.                            |
| 6,170,230    | B1   | 1/2001  | Chudy et al.                             |
| 6,176,392    | B1   | 1/2001  | William et al.                           |
| 6,189,727    | B1   | 2/2001  | Shoenfeld                                |
| 6,223,934    | B1   | 5/2001  | Shoenfeld                                |
| 6,256,967    | B1   | 7/2001  | Hebron et al.                            |
| 6,283,322    | B1   | 9/2001  | Liff et al.                              |
| 6,285,285    | B1   | 9/2001  | Mongrenier                               |
| 6,289,656    | B1   | 9/2001  | Wangu et al.                             |
| 6,337,631    | B1   | 1/2002  | Pai et al.                               |
| 6,338,007    | B1   | 1/2002  | Broadfield et al.                        |
| 6,339,732    | B1   | 1/2002  | Phoon et al.                             |
| 6,361,263    | B1   | 3/2002  | Dewey et al.                             |
| 6,370,841    | B1   | 4/2002  | Chudy et al.                             |
| 6,449,927    | B2   | 9/2002  | Hebron et al.                            |
| 6,471,089    | B2   | 10/2002 | Liff et al.                              |
| 6,497,342    | B2   | 12/2002 | Zhang et al.                             |
| 6,499,270    | B2   | 12/2002 | Peroni et al.                            |
| 6,532,399    | B2   | 3/2003  | Mase                                     |
| 6,564,121    | B1   | 5/2003  | Wallace et al.                           |
| 6,581,798    | B2   | 6/2003  | Liff et al.                              |
| 6,609,047    | B1   | 8/2003  | Lipps                                    |
| 6,611,733    | B1   | 8/2003  | De La Huerga                             |
| 6,625,952    | B1   | 9/2003  | Chudy et al.                             |
| 6,640,159    | B2   | 10/2003 | Holmes et al.                            |
| 6,650,964    | B2   | 11/2003 | Spano, Jr. et al.                        |
| 6,671,579    | B2   | 12/2003 | Spano, Jr. et al.                        |
| 6,681,149    | B2   | 1/2004  | William et al.                           |
| 6,690,280    | B2   | 2/2004  | Citrenbaum et al.                        |
| 6,742,671    | B2   | 6/2004  | Hebron et al.                            |
| 6,755,931    | B2   | 6/2004  | Vollm et al.                             |
| 6,760,643    | B2   | 7/2004  | Lipps                                    |
| 6,776,304    | B2   | 8/2004  | Liff et al.                              |
| 6,785,589    | B2   | 8/2004  | Eggenberger et al.                       |
| 6,790,198    | B1   | 9/2004  | White et al.                             |
| 6,814,254    | B2   | 11/2004 | Liff et al.                              |
| 6,814,255    | B2   | 11/2004 | Liff et al.                              |
| 6,847,861    | B2   | 1/2005  | Lunak et al.                             |
| 6,874,684    | B1   | 4/2005  | Denenberg et al.                         |
| 6,892,780    | B2   | 5/2005  | Vollm et al.                             |
| 6,895,304    | B2   | 5/2005  | Spano, Jr. et al.                        |
| 6,963,791    | B1   | 11/2005 | Frederick et al.                         |
| 6,975,922    | B2   | 12/2005 | Duncan et al.                            |
| 6,985,797    | B2   | 1/2006  | Spano, Jr. et al.                        |
| 6,989,796    | B2   | 1/2006  | Rahim                                    |
| 6,996,455    | B2   | 2/2006  | Eggenberger et al.                       |
| 7,010,389    | B2   | 3/2006  | Lunak et al.                             |
| 7,014,063    | B2   | 3/2006  | Shows et al.                             |
| 7,016,766    | B2   | 3/2006  | William et al.                           |
| 7,040,504    | B2   | 5/2006  | Broadfield et al.                        |
| 7,052,097    | B2   | 5/2006  | Meek, Jr. et al.                         |
| 7,072,737    | B2   | 7/2006  | Lunak et al.                             |
| 7,072,855    | B1   | 7/2006  | Godlewski et al.                         |
| 7,077,286    | B2   | 7/2006  | Shows et al.                             |
| 7,085,621    | B2   | 8/2006  | Spano, Jr. et al.                        |
| 7,092,796    | B2   | 8/2006  | Vanderveen                               |
| 7,093,755    | B2   | 8/2006  | Jordan et al.                            |
| 7,100,792    | B2   | 9/2006  | Hunter et al.                            |
| 7,103,419    | B2   | 9/2006  | Engleson et al.                          |
| 7,111,780    | B2   | 9/2006  | Broussard et al.                         |
| 7,139,639    | B2   | 11/2006 | Broussard et al.                         |
| 7,150,724    | B2   | 12/2006 | Morris et al.                            |
| 7,171,277    | B2   | 1/2007  | Engleson et al.                          |
| 7,218,231    | B2   | 5/2007  | Higham                                   |
| 7,228,198    | B2   | 6/2007  | Vollm et al.                             |
| 7,249,688    | B2   | 7/2007  | Hunter et al.                            |
| 7,348,884    | B2   | 3/2008  | Higham                                   |
| 7,417,729    | B2   | 8/2008  | Greenwald                                |
| 7,419,133    | B2   | 9/2008  | Clarke et al.                            |
| 7,426,425    | B2   | 9/2008  | Meek, Jr. et al.                         |
| 7,554,449    | B2   | 6/2009  | Higham                                   |
| 7,571,024    | B2   | 8/2009  | Duncan et al.                            |
| 7,588,167    | B2   | 9/2009  | Hunter et al.                            |
| 7,596,427    | B1   | 9/2009  | Frederick et al.                         |
| 7,783,383    | B2   | 8/2010  | Eliuk et al.                             |
| 7,821,401    | B2   | 10/2010 | Martin et al.                            |
| 7,956,751    | B2   | 6/2011  | Lenevez                                  |
| 7,982,612    | B2   | 7/2011  | Braun                                    |
| 8,094,028    | B2   | 1/2012  | Braun et al.                             |
| 2002/0188259 | A1   | 12/2002 | Hickle et al.                            |
| 2003/0117281 | A1   | 6/2003  | Sriharto et al.                          |
| 2004/0061994 | A1   | 4/2004  | Kerr et al.                              |
| 2005/0088305 | A1   | 4/2005  | Greene et al.                            |
| 2005/0258963 | A1 * | 11/2005 | Rodriguez ..... G03G 1/1878<br>340/572.1 |
| 2006/0102718 | A1   | 5/2006  | Kajino et al.                            |
| 2006/0108252 | A1   | 5/2006  | Lax                                      |
| 2006/0214864 | A1   | 9/2006  | Rahim                                    |
| 2006/0244599 | A1   | 11/2006 | Taylor et al.                            |
| 2006/0264778 | A1   | 11/2006 | Lim et al.                               |
| 2006/0289650 | A1   | 12/2006 | Taylor et al.                            |
| 2007/0027577 | A1   | 2/2007  | Lunak et al.                             |
| 2007/0229266 | A1   | 10/2007 | Gibson                                   |
| 2008/0051937 | A1   | 2/2008  | Khan et al.                              |
| 2008/0195246 | A1   | 8/2008  | Tribble et al.                           |
| 2008/0195416 | A1   | 8/2008  | Tribble et al.                           |
| 2009/0043253 | A1   | 2/2009  | Podaima                                  |
| 2009/0152363 | A1 * | 6/2009  | Kim ..... 235/492                        |
| 2009/0322545 | A1   | 12/2009 | Gibson et al.                            |
| 2010/0164710 | A1 * | 7/2010  | Chung et al. .... 340/539.1              |
| 2010/0214106 | A1 * | 8/2010  | Braun ..... 340/618                      |
| 2010/0245056 | A1 * | 9/2010  | Braun et al. .... 340/10.42              |
| 2010/0265068 | A1   | 10/2010 | Brackman et al.                          |
| 2011/0037567 | A1 * | 2/2011  | Knadle et al. .... 340/10.1              |
| 2011/0199212 | A1 * | 8/2011  | Matityaho et al. .... 340/572.7          |
| 2013/0154809 | A1 * | 6/2013  | Subramanian et al. .... 340/10.42        |

## OTHER PUBLICATIONS

For Health Technologies, Inc.; Intelliflow™ Rx, I.V. Workflow Manager, [http://www.fhtinc.com/FHZS\\_files/Blueprint\\_for\\_Your\\_I.V.\\_Room%27s\\_Future.pdf](http://www.fhtinc.com/FHZS_files/Blueprint_for_Your_I.V._Room%27s_Future.pdf), Mar. 30, 2009.

Valimed Medication Validation System; [www.ValiMed.com](http://www.valimed.com); <http://www.cdexinc.com/pages/valimedbrochure.pdf>, Mar. 30, 2009.

Carmel Pharma AB; PhaSeal® Protects Those Who Care™; Göteborg, Sweden; [www.carmelpharma.com](http://www.carmelpharma.com) Mar. 30, 2009.

Notice of Allowance for U.S. Appl. No. 12/342,749 dated Sep. 7, 2011.

Office Action for U.S. Appl. No. 12/342,749 dated Dec. 9, 2010.

Office Action for U.S. Appl. No. 12/342,749 dated May 11, 2011.

Notice of Allowance for U.S. Appl. No. 12/389,842 dated Mar. 15, 2011.

Response to Amendment for U.S. Appl. No. 12/389,842 dated May 3, 2011.

\* cited by examiner

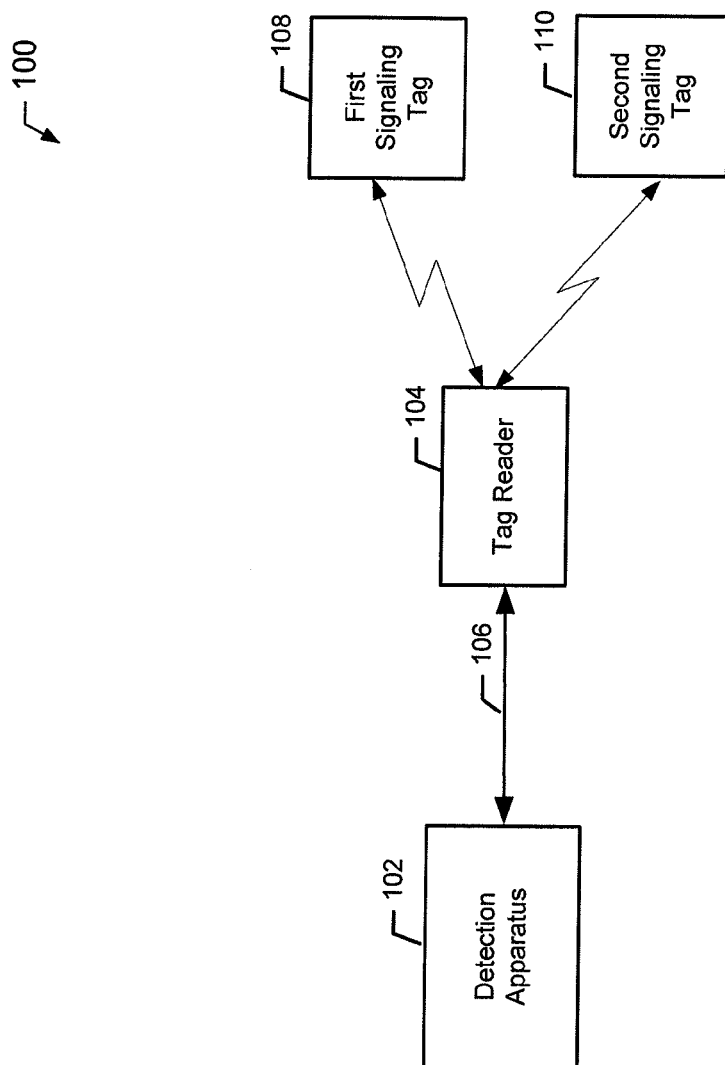
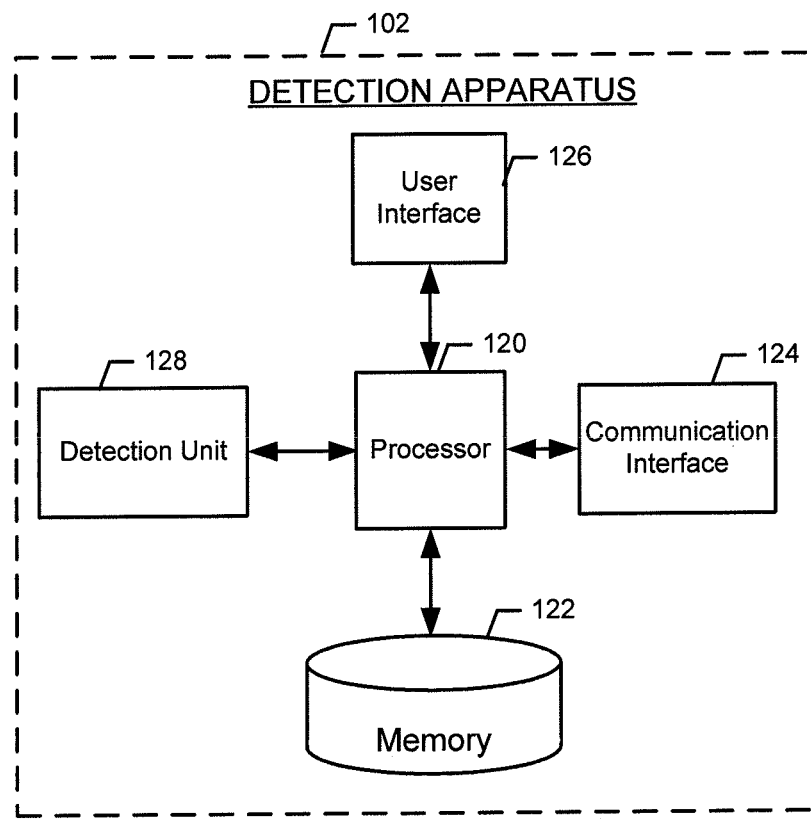


FIG. 1

FIG. 2

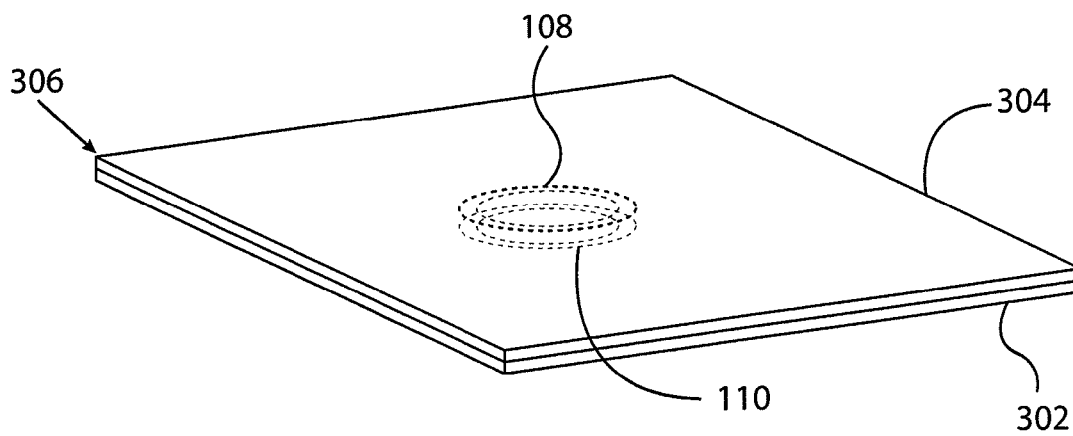


FIG. 3A

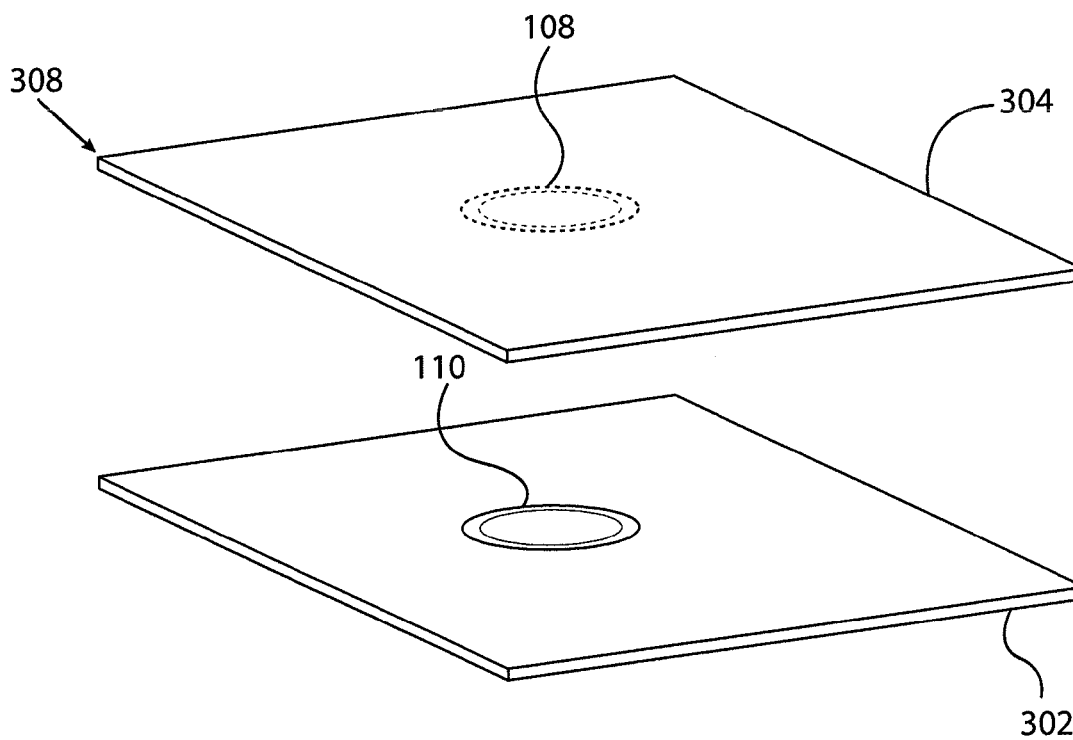


FIG. 3B

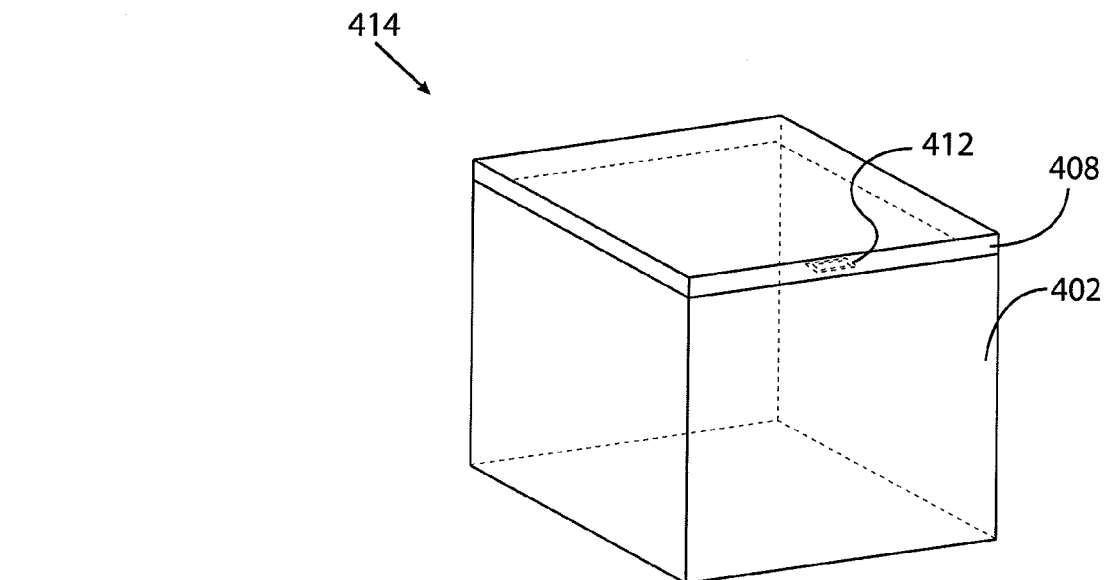


FIG. 4A

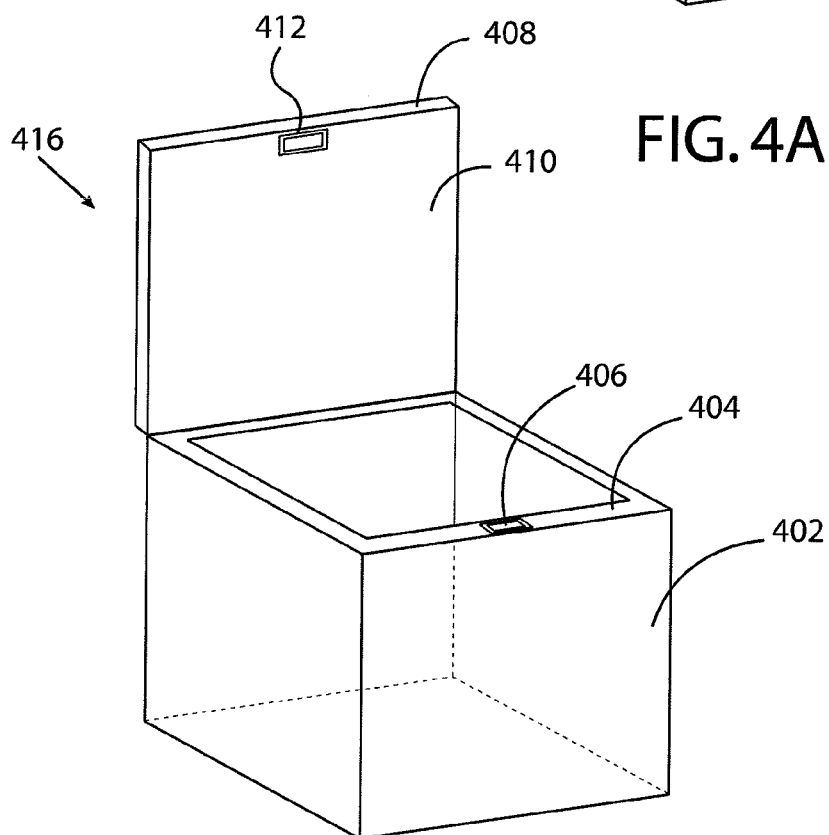


FIG. 4B

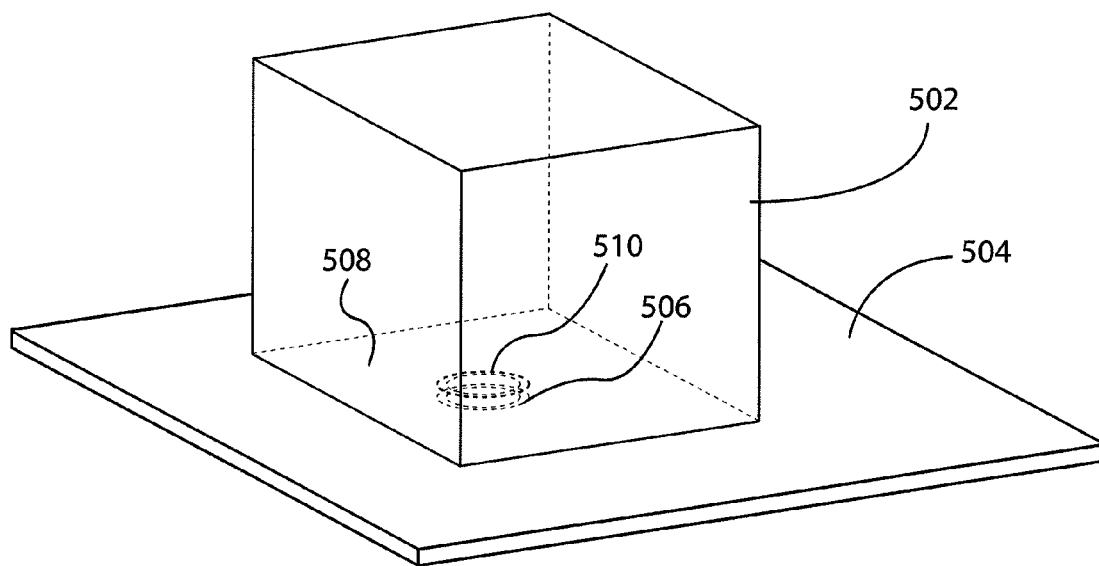


FIG. 5A

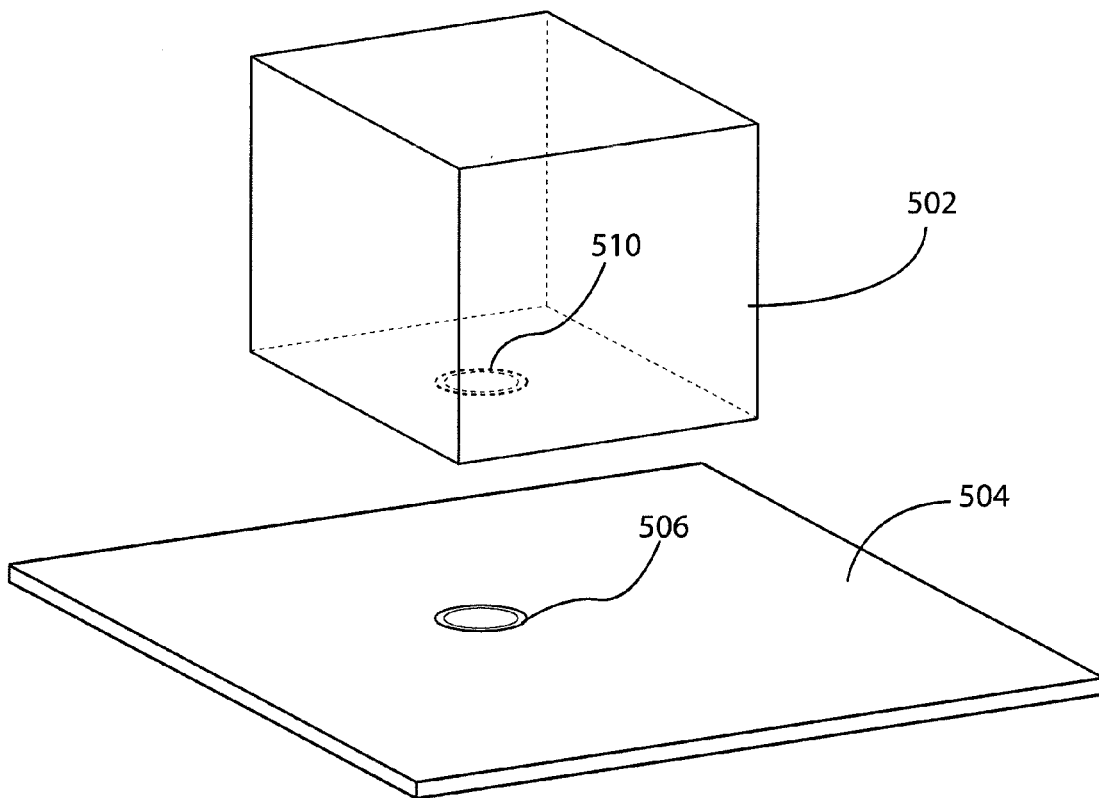


FIG. 5B

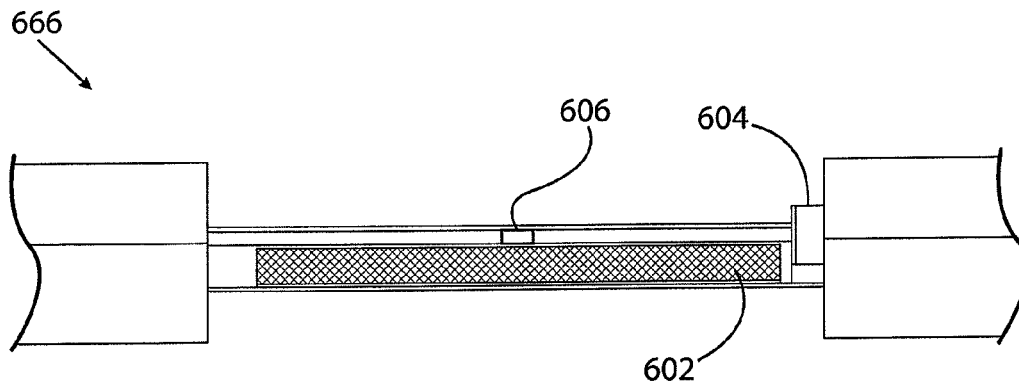


FIG. 6A

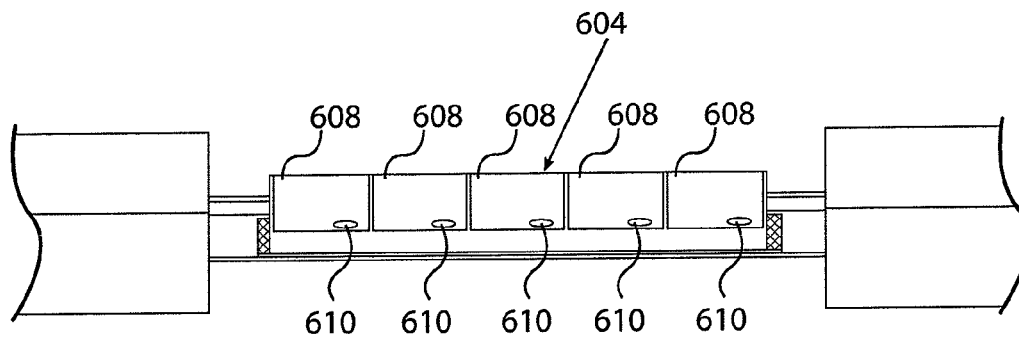


FIG. 6B

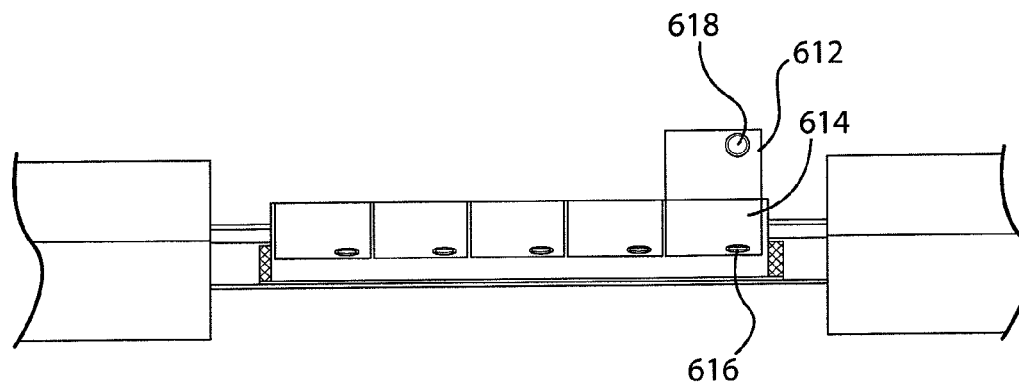


FIG. 6C



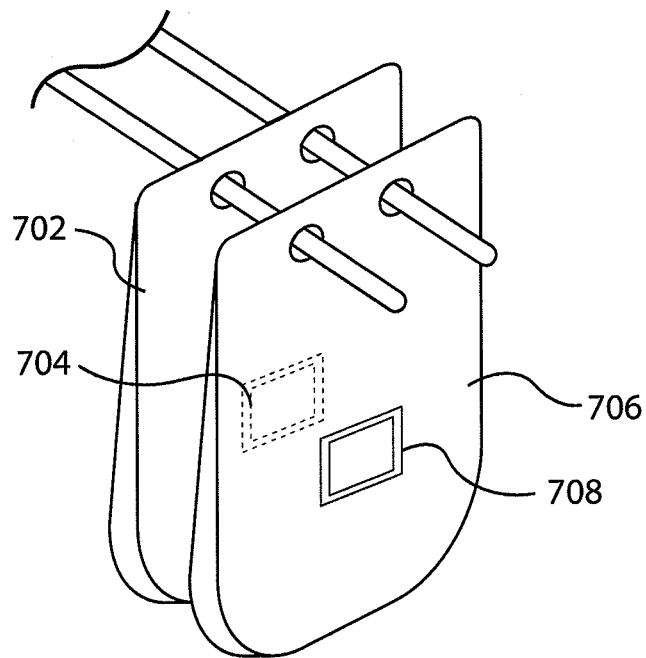


FIG. 7A

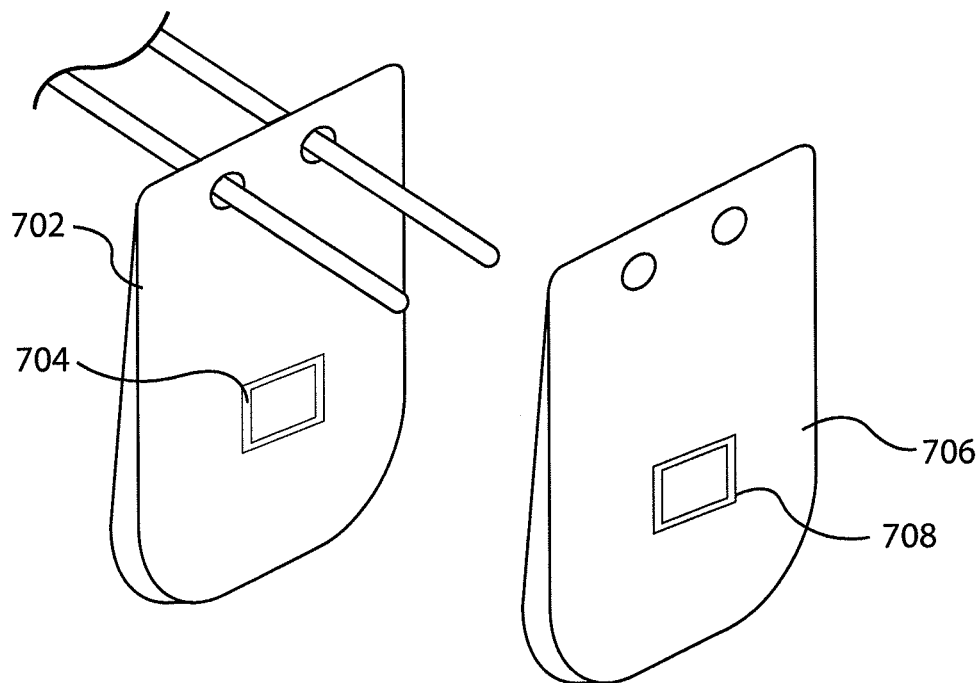
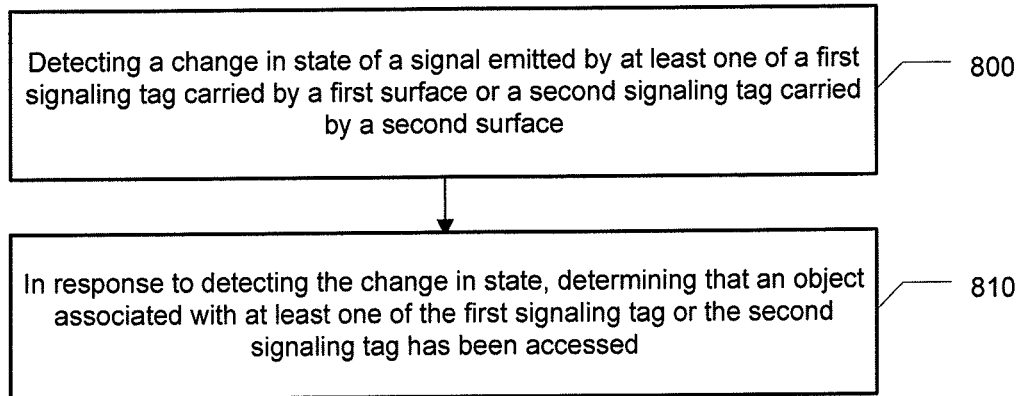


FIG. 7B

FIG. 8

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# SYSTEM, METHODS, APPARATUSES, AND COMPUTER PROGRAM PRODUCTS FOR DETECTING THAT AN OBJECT HAS BEEN ACCESSED

## TECHNOLOGICAL FIELD

Embodiments of the present invention relate generally to tracking access to items and, more particularly, relate to systems, methods, apparatuses, and computer program products for detecting that an object has been accessed.

## BACKGROUND

In many instances, access to objects may be controlled, such as for purposes of monitoring inventory, preventing unauthorized access to objects, and/or the like. For example, in the case of valuable objects and controlled items, such as medical items, it may be important to track access to objects to reduce the chance that an unauthorized party has accessed an object and/or to facilitate inventory tracking. Accordingly, efforts are ongoing to develop improved systems to enable detection of access to an object.

## BRIEF SUMMARY OF SOME EXAMPLES OF THE INVENTION

Systems, methods, apparatuses, and computer program products are herein provided for detecting that an object has been accessed. Systems, methods, and apparatuses in accordance with various embodiments provide several advantages to computing devices and organizations charged with managing inventory and/or tracking access to objects. In this regard, some example embodiments provide a system for detecting that an object has been accessed. More particularly, some example embodiments utilize a change in state of a signal emitted by one or more signaling tags resulting from a transition of a surface carrying a signaling tag from a first position to a second position to detect that an object has been accessed.

For example, in some example embodiments, a first signaling tag may be carried by a surface of a receptacle and a second signaling tag may be carried by a surface of a closure for the receptacle. When the closure is opened, a detectable change in state of a signal emitted by the first signaling tag and/or the second signaling tag may result such that it may be detected that the receptacle has been accessed. Accordingly, it may be determined that an item that may be stored in the receptacle has been accessed.

As another example, in some example embodiments, a first signaling tag may be carried by a surface of an object and a second signaling tag may be carried by a surface on which the object may rest. If the object is removed from the surface, a detectable change in state of a signal emitted by the first signaling tag and/or the second signaling tag may result such that it may be detected that the object has been accessed.

In a first example embodiment, a method for detecting that an object has been accessed is provided. The method may comprise detecting a change in state of a signal emitted by at least one of a first signaling tag carried by a first surface or a second signaling tag carried by a second surface. The change in state may result from the second surface being transitioned from a first position to a second position. The first signaling tag may be positioned on the first surface and the second signaling tag may be positioned on the second surface such that when the second surface is in the first position, the first signaling tag and the second signaling tag are sufficiently

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proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag. When the second surface is transitioned from the first position to the second position, a decoupling between the first signaling tag and the second signaling tag may result in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag. The method may further comprise, in response to detecting the change in state, determining that an object associated with at least one of the first signaling tag or the second signaling tag has been accessed.

In another example embodiment, an apparatus for detecting that an object has been accessed is provided. The apparatus of this example embodiment may comprise at least one processor. The at least one processor may be configured to cause the apparatus of this example embodiment to detect a change in state of a signal emitted by at least one of a first signaling tag carried by a first surface or a second signaling tag carried by a second surface. The change in state may result from the second surface being transitioned from a first position to a second position. The first signaling tag may be positioned on the first surface and the second signaling tag may be positioned on the second surface such that when the second surface is in the first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag. When the second surface is transitioned from the first position to the second position, a decoupling between the first signaling tag and the second signaling tag may result in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag. The at least one processor may be further configured to cause the apparatus of this example embodiment, in response to detecting the change in state, to determine that an object associated with at least one of the first signaling tag or the second signaling tag has been accessed.

In a further example embodiment, a computer program product for detecting that an object has been accessed is provided. The computer program product of this example embodiment includes at least one computer-readable storage medium having computer-readable program code portions stored therein. The computer-readable program code portions of this example embodiment may comprise a program code portion configured to detect a change in state of a signal emitted by at least one of a first signaling tag carried by a first surface or a second signaling tag carried by a second surface. The change in state may result from the second surface being transitioned from a first position to a second position. The first signaling tag may be positioned on the first surface and the second signaling tag may be positioned on the second surface such that when the second surface is in the first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag. When the second surface is transitioned from the first position to the second position, a decoupling between the first signaling tag and the second signaling tag may result in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag. The computer-readable program code portions of this example embodiment may further comprise a program code portion configured, in response to detecting the change

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in state, to determine that an object associated with at least one of the first signaling tag or the second signaling tag has been accessed.

In yet another example embodiment, a system for facilitating detection of an object being accessed is provided. The system of this example embodiment may comprise a first surface, a second surface, a first signaling tag carried by the first surface, and a second signaling tag carried by the second surface. The first signaling tag may be positioned on the first surface and the second signaling tag may be positioned on the second surface such that when the second surface is in a first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag. When the second surface is transitioned from the first position to a second position, a decoupling between the first signaling tag and the second signaling tag may result in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag.

The above summary is provided merely for purposes of summarizing some example embodiments of the invention so as to provide a basic understanding of some aspects of the invention. Accordingly, it will be appreciated that the above described example embodiments are merely examples and should not be construed to narrow the scope or spirit of the invention in any way. It will be appreciated that the scope of the invention encompasses many potential embodiments, some of which will be further described below, in addition to those here summarized.

#### BRIEF DESCRIPTION OF THE DRAWING(S)

Having thus described embodiments of the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates a system for detecting that an object has been accessed according to some example embodiments;

FIG. 2 illustrates a block diagram of a detection apparatus according to some example embodiments;

FIGS. 3A and 3B illustrate an example system for facilitating detection of an object being accessed according to some example embodiments;

FIGS. 4A and 4B illustrate another example system for facilitating detection of an object being accessed according to some example embodiments;

FIGS. 5A and 5B illustrate a further example system for facilitating detection of an object being accessed according to some example embodiments;

FIGS. 6A-6C illustrate an example system for facilitating detection of an object being accessed along a conveyor system according to some example embodiments;

FIGS. 7A-7B illustrate an example system for facilitating detection of a hanging bag being accessed from a rack of two or more hanging bags according to some example embodiments; and

FIG. 8 is a flowchart according to an example method for detecting that an object has been accessed according to some example embodiments.

#### DETAILED DESCRIPTION

Some embodiments of the present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of

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the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like reference numerals refer to like elements throughout. As used herein, the terms “data,” “content,” “information” and similar terms may be used interchangeably to refer to data capable of being transmitted, received, displayed and/or stored in accordance with various example embodiments. Thus, use of any such terms should not be taken to limit the spirit and scope of the disclosure. Further, where a computing device is described herein to receive data from or send data to another computing device, it will be appreciated that the data may be received directly from or sent directly to the another computing device, or may be received/sent indirectly via one or more intermediary computing devices, such as, for example, one or more servers, relays, routers, network access points, and/or the like.

FIG. 1 illustrates a system 100 for detecting that an object has been accessed according to some example embodiments. It will be appreciated that the apparatus 102, as well as the illustrations in other figures, are each provided as an example of some embodiments and should not be construed to narrow the scope or spirit of the disclosure in any way. In this regard, the scope of the disclosure encompasses many potential embodiments in addition to those illustrated and described herein. As such, while FIG. 1 illustrates one example of a configuration of a system for detecting that an object has been accessed, numerous other configurations may also be used to implement embodiments of the present invention.

In some example embodiments, the system 100 may comprise a detection apparatus 102. The detection apparatus may comprise any computing device or plurality of computing devices configured to interface with a tag reader 104 via a communications link 106 to receive an indication of a signal emitted by a signaling tag, such as the first signaling tag 108 and/or second signaling tag 110, and to detect a change in state of a signal emitted by a signaling tag based at least in part on the indication received from the tag reader 104. By way of non-limiting example, the detection apparatus 102 may comprise a desktop computer, laptop computer, mobile computing device, server, embedded computing device, and/or the like.

In some example embodiments, the first signaling tag 108 and/or second signaling tag 110 may comprise radio frequency (RF) tags. Accordingly, the description herein of some embodiments of the invention refers to a signaling tag (e.g., the signaling tags 108 and 110) as RF tags for purposes of example to describe a radio frequency signal as one type of signal that may be emitted by a signaling tag. It will be appreciated, however, that a signaling tag, such as the signaling tags 108 and 110, may be configured to emit detectable signals other than radio frequency, such as, for example, ultrasound signals, optical signals, electrical current, electrical voltage, an electrical field, a magnetic field, and/or the like. It will thus be appreciated that wherever reference is made to RF tags herein, it is merely one example of a signaling tag and accordingly other types of signaling tags may be substituted for RF tags.

It will be further appreciated that in some example embodiments a signaling tag, such as the first signaling tag 108 or second signaling tag 110, may comprise either an active tag or a passive tag (e.g., an active or passive RF tag). Accordingly, a reader used to monitor a state of a signal emitted by the signaling tag may be configured to passively monitor the signal state or to actively interrogate the signaling tag. As such, any signal emitted by a signaling tag may be emitted in

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response to being interrogated by the tag reader **104**, if the signaling tag is embodied as a passive tag.

The tag reader **104** may be embodied as any signaling tag reader configured to read a signal that may be emitted by a signaling tag(s) (e.g., the first signaling tag **108**, second signaling tag **110**, and/or other signaling tag) such that a change in state of the signal may be detected by the detection apparatus **102**. As an example, the tag reader **104** may, for example, comprise an RF tag reader in embodiments in which one or more of the first signaling tag **108** or second signaling tag **110** comprise RF tags. Depending on embodiments of the first signaling tag **108** and second signaling tag **110**, the tag reader **104** may be configured to passively read an emitted signal (e.g., for an active RF tag) and/or to actively interrogate the signaling tag **16** (e.g., for a passive RF tag). The tag reader **104** may be located anywhere within sufficient proximity to detect a change in state of a signal emitted by one or more of the first signaling tag **108** or second signaling tag **110**. The tag reader **104** may, for example, be positioned at a location at which an object to be monitored may be accessed. For example, the tag reader **104** may be positioned at a dispensary where health care items (e.g., medical supplies, drugs, and/or the like) may be maintained in one or more receptacles so that access to the health care items may be monitored. As another example, the tag reader **104** may be positioned at a station along a conveyor system on which an object may be moved. In this regard, if the object is accessed at the station, the tag reader **104** of such example embodiments may be configured to enable detection that the object has been accessed.

Although referred to as a tag reader, it will be appreciated that the tag reader **104** may comprise a system comprising a plurality of components. For example, the tag reader **104** may comprise a tag reader component connected to one or more antennas configured to receive a signal emitted by a signaling tag and transmit the signal to the tag reader component so that the tag reader component may read the signal.

In some embodiments, the communications link **106** comprises a direct wired connection or wireless communications link between the tag reader **104** and detection apparatus **102**. Additionally or alternatively, in some example embodiments, the communications link **106** comprises a network (e.g., a wireline network, wireless network, or some combination thereof) through which the tag reader **104** and detection apparatus **102** may be interfaced.

Referring now to FIG. 2, FIG. 2 illustrates a block diagram of a detection apparatus **102** according to some example embodiments. In some example embodiments, the detection apparatus **102** includes various means for performing the various functions described herein. These means may include, for example, one or more of a processor **120**, memory **122**, communication interface **124**, user interface **126**, or detection unit **128** for performing the various functions herein described. The means of the apparatus **102** as described herein may be embodied as, for example, circuitry, hardware elements (e.g., a suitably programmed processor, combinational logic circuit, and/or the like), a computer program product comprising a computer-readable medium (e.g. memory **122**) storing computer-readable program instructions (e.g., software or firmware) that are executable by a suitably configured processing device (e.g., the processor **120**), or some combination thereof.

The processor **120** may, for example, be embodied as various means including one or more microprocessors, one or more coprocessors, one or more multi-core processors, one or more controllers, processing circuitry, one or more computers, various other processing elements including integrated circuits such as, for example, an ASIC (application specific

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integrated circuit) or FPGA (field programmable gate array), or some combination thereof. Accordingly, although illustrated in FIG. 2 as a single processor, in some embodiments the processor **120** may comprise a plurality of processors. The plurality of processors may be embodied on a single computing device or may be distributed across a plurality of computing devices collectively configured to function as the detection apparatus **102**. The plurality of processors may be in operative communication with each other and may be collectively configured to perform one or more functionalities of the detection apparatus **102** as described herein. In some embodiments, the processor **120** may be configured to execute instructions stored in the memory **122** or otherwise accessible to the processor **120**. These instructions, when executed by the processor **120**, may cause the detection apparatus **102** to perform one or more of the functionalities of the apparatus **102** as described herein. As such, whether configured by hardware or software methods, or by a combination thereof, the processor **120** may comprise an entity capable of performing operations according to embodiments of the present invention while configured accordingly. Thus, for example, when the processor **120** is embodied as an ASIC, FPGA or the like, the processor **120** may comprise specifically configured hardware for conducting one or more operations described herein. Alternatively, as another example, when the processor **120** is embodied as an executor of instructions, such as may be stored in the memory **122**, the instructions may specifically configure the processor **120** to perform one or more algorithms and operations described herein.

The memory **122** may include, for example, volatile and/or non-volatile memory. Although illustrated in FIG. 2 as a single memory, the memory **122** may comprise a plurality of memories. The plurality of memories may be embodied on a single computing device or distributed across a plurality of computing devices. The memory **122** may comprise, for example, a hard disk, random access memory, cache memory, flash memory, an optical disc (e.g., a compact disc read only memory (CD-ROM), digital versatile disc read only memory (DVD-ROM), or the like), circuitry configured to store information, or some combination thereof. In this regard, the memory **122** may comprise any non-transitory computer readable storage medium. The memory **122** may be configured to store information, data, applications, instructions, and/or the like for enabling the detection apparatus **102** to carry out various functions in accordance with example embodiments of the present invention. For example, in some example embodiments, the memory **122** is configured to buffer input data for processing by the processor **120**. Additionally or alternatively, in some example embodiments, the memory **122** is configured to store program instructions for execution by the processor **120**. The memory **122** may store information in the form of static and/or dynamic information. This stored information may be stored and/or used by the detection unit **128** during the course of performing its functionalities.

In some example embodiments, the detection apparatus **102** may include a communication interface(s), such as the communication interface **124**. In embodiments including a communication interface, the communication interface **124** may be embodied as any device or means embodied in circuitry, hardware, a computer program product comprising a computer readable medium (e.g., the memory **122**) storing computer readable program instructions executed by a processing device (e.g., the processor **120**), or a combination thereof that is configured to receive and/or transmit data from/to another device with which the detection apparatus **102** may be in communication. In some example embodiments, the

communication interface **124** is at least partially embodied as or otherwise controlled by the processor **120**. In this regard, the communication interface **124** may be in communication with the processor **120**, such as via a bus. The communication interface **124** may additionally be in communication with the memory **122**, user interface **126**, and/or detection unit **128**, such as via a bus. The communication interface **124** may include, for example, an antenna, a transmitter, a receiver, a transceiver and/or supporting hardware or software for enabling communications with another computing device. The communication interface **124** may be configured to receive and/or transmit data using any protocol that may be used for communications between computing devices. As an example, the communication interface **124** may be configured to be configured receive and/or transmit data from/to the tag reader **104** via the communication link **106**.

In some example embodiments, the detection apparatus **102** may include a user interface **126**. However, in other embodiments, such as some example embodiments in which the detection apparatus **102** is embodied as a server or embedded device, some aspects of the user interface **126** may be limited, or the user interface **126** may be omitted altogether. The user interface **126** may be in communication with the processor **120** to receive an indication of a user input and/or to provide an audible, visual, mechanical, or other output to a user. As such, the user interface **126** may include, for example, a keyboard, a mouse, a joystick, a display, a touch screen display, a microphone, a speaker, and/or other input/output mechanisms. The user interface **126** may be in communication with the memory **122**, communication interface **124**, and/or detection unit **128**, such as via a bus.

The detection unit **128** may be embodied as various means, such as circuitry, hardware, a computer program product comprising a computer readable medium (e.g., the memory **122**) storing computer readable program instructions executed by a processing device (e.g., the processor **120**), or some combination thereof and, in some example embodiments, is embodied as or otherwise controlled by the processor **120**. In embodiments wherein the detection unit **128** is embodied separately from the processor **120**, the detection unit **128** may be in communication with the processor **120**. The detection unit **128** may further be in communication with one or more of the memory **122**, communication interface **124**, or user interface **126**, such as via a bus.

FIGS. 3A and 3B illustrate an example system **300** that may be used with the system **100** to facilitate detection of an object being accessed according to some example embodiments. In some example embodiments, the first signaling tag **108** may be carried by a first surface **302** and the second signaling tag **110** may be carried by a second surface **304**. While the surfaces **302** and **304** are illustrated in FIGS. 3A and 3B as being substantially planar, it will be appreciated that the signaling tags **108** and **110** may be carried by any type of surface, including non-planar surfaces. In some example embodiments, a signaling tag may be carried by a surface through attachment to a face of a surface. As another example, in some example embodiments, a signaling tag may be carried by a surface through integration of the signaling tag into the surface. In some example embodiments, the first surface **302** and/or second surface **304** may comprise a surface of an object, access of which may be detected in accordance with one or more example embodiments.

The first signaling tag **108** may be positioned on the first surface **302** and the second signaling tag **110** may be positioned on the second surface **304** such that when the second surface **304** is in the first position **306** illustrated in FIG. 3A, the first signaling tag **108** and the second signaling tag **110** are

sufficiently proximate to each other such that a coupling occurs between the first signaling tag **108** and the second signaling tag **110** resulting in a first signal state being emitted by at least one of the first signaling tag **108** or the second signaling tag **110**. If the second surface **304** is transitioned to a position, such as the second position **308** illustrated in FIG. 3B, in which the first signaling tag **108** and second signaling tag **110** are no longer sufficiently proximate to each other to result in a coupling between the first signaling tag **108** and the second signaling tag **110**, a decoupling between the first signaling tag **108** and the second signaling tag **110** may result in a second signal state being emitted by at least one of the first signaling tag **108** or the second signaling tag **110**. Transitioning of the second surface **304** from the first position **306** to the second position **308** may, for example, result from human manipulation, machine manipulation, and/or any other force which may result in transition of the second surface **304** from the first position **306** to the second position **308**.

Accordingly, when the second surface **304** is transitioned from the first position **306** to the second position **308**, a change in state of a signal emitted by one or more of the first signaling tag **108** or the second signaling tag **110** may result. As a signal emitted by the first signaling tag **108** and/or second signaling tag **110** may be read by the tag reader **104**, the detection unit **128** may be configured to detect the change in state based at least in part on the indication of a read state received from the tag reader **104**.

It will be appreciated that a change in state resulting from transition of the surface **304** from first position **306** to second position **308** may comprise any of a variety of changes in state. For example, in some example embodiments wherein both the first signaling tag **108** and the second signaling tag **110** comprise RF tags, when the second surface **304** is in the first position **306** such that the signaling tags **108** and **110** are within sufficient proximity of each other to couple, an antenna(s) of one or more of the first signaling tag **108** or the second signaling tag **110** may be detuned such that the antenna does not emit a readable or otherwise detectable signal. However, when the second surface **304** is transitioned to the second position **308** such that the signaling tags **108** and **110** decouple, the detuned antenna(s) may become tuned and emit a readable signal. Accordingly, in some embodiments, the signal state change comprises emission of a readable signal from a signaling tag that was not previously emitting a readable signal.

In another example, in some example embodiments in which both the first signaling tag **108** and the second signaling tag **110** comprise RF tags, when the second surface **304** is in the first position **306** such that the signaling tags **108** and **110** are within sufficient proximity of each other to couple, the coupling may cause an antenna(s) of one or more of the first signaling tag **108** or the second signaling tag **110** to emit a readable or otherwise detectable signal. However, when the second surface **304** is transitioned to the second position **308** such that the signaling tags **108** and **110** decouple, the antenna(s) may become detuned such that a readable signal is no longer emitted. Accordingly, in some embodiments, the signal state change comprises cessation of emission of a readable signal from a signaling tag that was previously emitting a readable signal.

In yet another example, the signaling tags **108** and **110** may each comprise a primary antenna and a secondary antenna. The primary antennas may be configured to emit a readable or otherwise detectable signal when the second surface **304** is in the first position **306** such that the signaling tags **108** and **110** are within sufficient proximity to couple, while the secondary antennas may be detuned so that the secondary antennas do

not emit a readable signal. However, when the second surface **304** is transitioned to the second position **308** such that the signaling tags **108** and **110** decouple, the secondary antennas may be activated and emit a readable signal. Accordingly, in some embodiments, the signal state change comprises emission of a second or new readable signal from one or more of the first signaling tag **108** or the second signaling tag **110**. The new emitted signal may be in addition to that initially emitted by the primary antennas or in lieu of the initial signal emitted by the primary antennas when the second surface **304** was in the first position **306**.

In still a further example, the signaling tag **108** and/or signaling tag **110** may be configured to emit a signal having a first communication field and/or a first frequency when the second surface **304** is in the first position **306** and the signaling tags **108** and **110** are within sufficient proximity to couple with each other. When the second surface **304** is transitioned to the second position **308** such that the signaling tags **108** and **110** decouple, the signaling tag **108** and/or signaling tag **110** may be configured to emit a signal having a second communication field and/or a second frequency. The tag reader **104** and/or detection unit **128** may be configured to differentiate between the first and second communication fields/frequencies. In some embodiments, the first communication field may comprise a near-field UHF signal that has different characteristics and properties from the second communication field, which may comprise a far-field UHF signal. In other embodiments, the second frequency may comprise a near-field UHF signal and the first frequency may comprise a far-field UHF signal. Accordingly, in some example embodiments, the change in state may comprise a change from a first communication field/frequency to a second communication field/frequency.

In yet another example, decoupling of the signaling tags **108** and **110** may result in one or more of the signaling tag **108** or the signaling tag **110** varying the amplitude (e.g., increasing the amplitude, decreasing the amplitude, or the like) of an emitted signal such that the tag reader **104** and/or detection unit **128** may detect the amplitude variation when the surface **304** is transitioned to the second position **308**.

It will be appreciated that the above described example changes in signal state are merely examples of some example embodiments. In this regard, embodiments may utilize any measurable change in signal state triggered when the second surface **304** is transitioned to the second position **308** such that the first signaling tag **108** and the second signaling tag **110** decouple.

In some example embodiments, the detection unit **128** may be configured to determine, in response to the detected change in state, that an object associated with one or more of the first signaling tag **108** or the second signaling tag **110** has been accessed. For example, in some embodiments, a signal emitted by one or more of the first signaling tag **108** or the second signaling tag **110** may carry a unique code or other signaling tag identifier that identifies the particular signaling tag. This signaling tag identifier may be read by the tag reader **104** and may be interpreted by the detection unit **128**. The signaling tag identifier may be associated with a particular object. Information may be stored, such as in a database, in the memory **122** correlating signaling tag identifiers for one or more signaling tags to associated objects. The detection unit **128** may accordingly be configured in some example embodiments to retrieve information associated with a particular signaling tag by determining the signaling tag identifier from a detected signal read by the tag reader **104** and looking up the signaling tag identifier to retrieve the informa-

tion associated with the signaling tag, which may be used to identify an object that has been accessed.

The detection unit **128** may be further configured to log an entry in a database or other record reflecting that the object has been accessed. Accordingly, an object may be tracked, such as for purposes of inventory management, enforcing privileged access restrictions, and/or the like.

In some example embodiments, an accessed object may comprise and/or may be associated with a particular item. For example, in some example embodiments, such as that illustrated in FIGS. **4A** and **4B**, an object may comprise a receptacle in which one or more items may be maintained. It will be appreciated that an item associated with an accessed object may comprise any type of item for which it may be desirable to track access to the item, such as for inventory purposes, enforcing privileged access restrictions, and/or the like. For example, the item may comprise a health care item, such as a medical supply, drug, and/or the like.

In some example embodiments, the first signaling tag **108** and second signaling tag **110** may each emit a signal indicative of a unique identifier associated with the tags. Accordingly, the first signaling tag **108** may be configured to emit a signal indicative of a first identifier that identifies the first signaling tag **108**, and the second signaling tag **110** may be configured to emit a signal indicative of a second identifier that identifies the second signaling tag **110**. In some such example embodiments, if there is a change in state of only one of the first signaling tag **108** or the second signaling tag **110**, in an instance in which the second surface **304** is transitioned to the second position **308**, the detection unit **128** may be configured to determine that the signaling tag for which a change in state is not detected is defective. Accordingly, such example embodiments may be used to identify potentially defective signaling tags so that they may be replaced. It will be appreciated, however, that in other example embodiments, the first signaling tag **108** and second signaling tag **110** may be configured to emit signals conveying identical or otherwise non-unique identifiers.

FIGS. **4A** and **4B** illustrate another example system for facilitating detection of an object being accessed according to some example embodiments. In this regard, FIGS. **4A** and **4B** illustrate an example embodiment in which the object comprises a receptacle **402**. While illustrated as a box in FIGS. **4A** and **4B**, it will be appreciated that the receptacle **402** may take on any form having an interior portion that is configured to serve as a receptacle for (e.g., contain) one or more items. The receptacle **402** may comprise a surface **404**, which may carry a signaling tag **406**. The surface **404** and signaling tag **406** may correspond to some embodiments of the first surface **302** and first signaling tag **108**, respectively.

The embodiments illustrated in FIGS. **4A** and **4B** may further comprise a closure **408** for the receptacle **402**. While illustrated in FIGS. **4A** and **4B** as a hinged lid, it will be appreciated that the closure **408** may take any of a variety of forms that may be used to close or otherwise limit access to the interior portion of the receptacle **402**. Accordingly, the form of the closure **408** may depend at least in part on the form of the receptacle **402**. By way of non-limiting example, the closure **408** may comprise a non-hinged lid, a cover, a cap, plug, and/or other type of closure that may restrict access to the interior portion of the receptacle **402** when the closure **408** is in a closed position, such as the closed position **414** illustrated in FIG. **4A**. The closure **408** may comprise a surface **410**, which may carry a signaling tag **412**. The surface **410** and signaling tag **412** may correspond to some embodiments of the second surface **304** and second signaling tag **110**, respectively.

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When the closure 408 is in the closed position 414, the signaling tag 406 and signaling tag 412 may be positioned on the surfaces 404 and 410, respectively, such that the signaling tags 406 and 412 couple. When the closure 408 is transitioned from the closed position 414 to an open position, such as the open position 416 illustrated in FIG. 4B, the signaling tags 406 and 412 may decouple such that a detectable change in state of a signal emitted by one or more of the signaling tag 406 or the signaling tag 412 may result. Accordingly, in such example embodiments, the detection unit 128 may be configured to detect the change in state and, in response to the change in state, determine that the receptacle 402 has been accessed.

In some such example embodiments, the detection unit 128 may be configured to further determine that an item has been added to the receptacle 402 and/or that an item has been removed from the receptacle 402 in response to a detected change in state. For example, if the receptacle 402 is associated with storage of a particular healthcare item, the detection unit 128 may be configured to determine based at least in part on detection of the change in state that the associated healthcare item has been removed from and/or added to the receptacle 402.

FIGS. 5A and 5B illustrate a further example system for facilitating detection of an object being accessed according to some example embodiments. In the example of FIG. 5A, an object 502 is illustrated as resting on a surface 504. The surface 504 may carry a signaling tag 506. The surface 504 and signaling tag 506 may correspond to some embodiments of the first surface 302 and first signaling tag 108, respectively. The object 502 may comprise a surface 508, which may carry a signaling tag 510. The surface 508 and signaling tag 510 may correspond to some embodiments of the second surface 304 and second signaling tag 110, respectively.

When the object 502 is resting on the surface 504 in the position illustrated in FIG. 5A, the signaling tags 506 and 510 may be positioned on the surfaces 504 and 508, respectively, such that the signaling tags 506 and 510 couple. When the object 502 is transitioned from the position illustrated in FIG. 5A to the position illustrated in FIG. 5B such that the object 502 is no longer resting on the surface 504, the signaling tags 506 and 510 may decouple such that a detectable change in state of a signal emitted by one or more of the signaling tag 506 or the signaling tag 510 may result. Accordingly, in such example embodiments, if the object 502 is accessed and removed from the surface 504, removal of the object 502 from the surface 504 may be detected by the detection unit 128.

FIGS. 6A-6C illustrate an example system for facilitating detection of an object being accessed along a conveyor system according to some example embodiments. Referring first to FIG. 6A, a conveyor system 600 is illustrated. The conveyor system 600 may include a conveyor 602 that may be configured to transport an object 604, which may comprise a bin, tray, or other object comprising one or more receptacles through the conveyor system 600. While illustrated in the examples of FIGS. 6A-6C as a belt conveyor, it will be appreciated that any type of conveying mechanism that may transport the object 604 may be substituted for the belt conveyor in other example embodiments. The conveyor system may include one or more stations. A station may comprise a location along the conveyor system at which the object 604 may be accessed. A tag reader 606 may be positioned at a station along the conveyor system. The tag reader 606 may correspond to an embodiment of the tag reader 104, and may be coupled to a detection apparatus 102 via a communication link 106.

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Referring to FIG. 6B, the object 604 may be stopped at the station, such as within proximity of the tag reader 606. In the example illustrated in FIGS. 6A-6C, the object 604 may comprise a tray comprising a plurality of bins 608. Each bin 608 may have an interior receptacle portion for containing one or more items and a closure, such as a hinged lid. In FIG. 6B, the closure of each bin 608 is in a closed position. Each bin 608 may include a set of signaling tags 610. The set of signaling tags 610 may correspond to a set including an embodiment of a first signaling tag 108 and a second signaling tag 110. When the bins 608 are in the closed position illustrated in FIG. 6B, the signaling tags in the signaling tag sets 610 may couple. However, as illustrated in FIG. 6C, if a closure 612 of a receptacle portion 614 of one of the bins 608 is opened, a signaling tag 616 that may be carried by a surface of the receptacle portion 614 and a signaling tag 618 that may be carried by a surface of the closure 612 may decouple. The decoupling may result in a change in state of a signal that may be emitted by one or more of the signaling tag 616 or the signaling tag 618. This change in state may be detected by the detection unit 128 via an indication that may be received from the tag reader 606 such that access to a bin 608 at the station may be detected.

FIGS. 7A-7B illustrate an example system for facilitating detection of a hanging bag being accessed from a rack of two or more hanging bags according to some example embodiments. In this example, two or more bags or other containers may be hung from a rod or other hanging device. The bags may contain items, such as medication (e.g., vials, blister packs of medication, fluid, and/or the like). In the example of FIGS. 7A and 7B, a first bag 702 may carry a signaling tag 704 on a surface of the first bag 702. A second bag 706 may carry a signaling tag 708 on a surface of the second bag 706. When the first bag 702 and second bag 706 are positioned adjacent to each other on the hanging rod, as illustrated in FIG. 7A, the signaling tags 704 and 708 may couple. However, when the second bag 706 is transitioned to a position farther from the first bag 702, such as in FIG. 7B in which the second bag 706 has been removed from the hanging rod, the signaling tags 704 and 708 may decouple such that a detectable change in state of a signal emitted by one or more of the signaling tag 704 or the signaling tag 708 may result. Accordingly, in such example embodiments, if a bag, such as the second bag 706, is removed from the hanging rod, removal of the bag may be detected by the detection unit 128.

FIG. 8 illustrates a flowchart according to an example method for detecting that an object has been accessed according to some example embodiments. In this regard, FIG. 8 illustrates a method that may be at least partially performed by a detection apparatus 102. The operations illustrated in and described with respect to FIG. 8 may, for example, be performed by, with the assistance of, and/or under the control of one or more of the processor 120, memory 122, communication interface 124, user interface 126, or detection unit 128. Operation 800 may comprise detecting a change in state of a signal emitted by at least one of a first signaling tag carried by a first surface or a second signaling tag carried by a second surface. Detection may, for example, be based at least in part on an indication received from a tag reader 104. The processor 120, memory 122, communication interface 124, and/or detection unit 128 may, for example, provide means for performing operation 800. Operation 810 may comprise, responsive to detecting the change in state, determining that an object associated with at least one of the first signaling tag or the second signaling tag has been accessed. The processor



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120, memory 122, communication interface 124, and/or detection unit 128 may, for example, provide means for performing operation 810.

FIG. 8 illustrates a flowchart of a system, method, and computer program product according to example embodiments of the invention. It will be understood that each block of the flowchart, and combinations of blocks in the flowchart, may be implemented by various means, such as hardware and/or a computer program product comprising one or more computer-readable mediums having computer readable program instructions stored thereon. For example, one or more of the procedures described herein may be embodied by computer program instructions of a computer program product. In this regard, the computer program product(s) which embody the procedures described herein may be stored by one or more memory devices of a server, desktop computer, laptop computer, mobile computer, or other computing device (e.g., a detection apparatus 102) and executed by a processor (e.g., the processor 120) in the computing device. In some embodiments, the computer program instructions comprising the computer program product(s) which embody the procedures described above may be stored by memory devices of a plurality of computing devices. As will be appreciated, any such computer program product may be loaded onto a computer or other programmable apparatus to produce a machine, such that the computer program product including the instructions which execute on the computer or other programmable apparatus creates means for implementing the functions specified in the flowchart block(s). Further, the computer program product may comprise one or more computer-readable memories on which the computer program instructions may be stored such that the one or more computer-readable memories can direct a computer or other programmable apparatus to function in a particular manner, such that the computer program product comprises an article of manufacture which implements the function specified in the flowchart block(s). The computer program instructions of one or more computer program products may also be loaded onto a computer or other programmable apparatus to cause a series of operations to be performed on the computer or other programmable apparatus to produce a computer-implemented process such that the instructions which execute on the computer or other programmable apparatus implement the functions specified in the flowchart block(s).

Accordingly, blocks or steps of the flowchart support combinations of means for performing the specified functions and combinations of steps for performing the specified functions. It will also be understood that one or more blocks of the flowcharts, and combinations of blocks in the flowchart, may be implemented by special purpose hardware-based computer systems which perform the specified functions or steps, or combinations of special purpose hardware and computer program product(s).

The above described functions may be carried out in many ways. For example, any suitable means for carrying out each of the functions described above may be employed to carry out embodiments of the invention. In one embodiment, a suitably configured processor may provide all or a portion of the elements of the invention. In another embodiment, all or a portion of the elements of the invention may be configured by and operate under control of a computer program product. The computer program product for performing the methods of embodiments of the invention includes a computer-readable storage medium, such as the non-volatile storage medium, and computer-readable program code portions, such as a series of computer instructions, embodied in the computer-readable storage medium.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the

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teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the embodiments of the invention are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Moreover, although the foregoing descriptions and the associated drawings describe example embodiments in the context of certain example combinations of elements and/or functions, it should be appreciated that different combinations of elements and/or functions may be provided by alternative embodiments without departing from the scope of the appended claims. In this regard, for example, different combinations of elements and/or functions than those explicitly described above are also contemplated as may be set forth in some of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A method for detecting that an object has been accessed, the method comprising:

detecting a change in state of a signal emitted by at least one of a first signaling tag carried by a first surface or a second signaling tag carried by a second surface, the change in state resulting from the second surface being transitioned from a first position to a second position, wherein the first signaling tag is positioned on the first surface and the second signaling tag is positioned on the second surface such that when the second surface is in the first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag, whereby an antenna of at least one of the first signaling tag or the second signaling tag is at least partially detuned by the coupling, thereby resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag, and wherein when the second surface is transitioned from the first position to the second position, wherein transitioning from the first position to the second position increases the distance between the first signaling tag and the second signaling tag such that a decoupling between the first signaling tag and the second signaling tag results in the antenna of at least one of the first signaling tag or the second signaling tag no longer being at least partially detuned, thereby resulting in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag; and

in response to detecting the change in state, determining, by a processor, that an object associated with at least one of the first signaling tag or the second signaling tag has been accessed.

2. The method of claim 1, further comprising: logging an entry in a database reflecting that the object has been accessed.

3. The method of claim 1, wherein the object comprises a receptacle in which a healthcare item is stored, the method further comprising determining, in response to detecting the change in state, that the healthcare item has been accessed.

4. The method of claim 1, wherein the object comprises a receptacle, the method further comprising determining, in response to detecting the change in state, one of that an item has been added to the receptacle or that an item has been removed from the receptacle.

5. The method of claim 1, wherein detecting the change in state comprises detecting the change in state based at least in part on an indication received from a tag reader positioned at a station along a conveyor system used to move the object, the

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tag reader being configured to read a signal emitted by one or more of the first signaling tag or the second signaling tag.

6. The method of claim 1, wherein in an instance in which a change in state is detected for only one of the first signaling tag or the second signaling tag, the method further comprises: determining that the one of the first signaling tag or the second signaling tag for which a change in state is not detected is defective.

7. The method of claim 1, wherein the first surface comprises a surface of a receptacle, and wherein the second surface comprises a surface of a closure for the receptacle.

8. The method of claim 1, wherein the change in state comprises emission of a readable signal from at least one of the first signaling tag or the second signaling tag, wherein the at least one of the first signaling tag or the second signaling tag did not emit a readable signal in the first signal state.

9. The method of claim 1, wherein the change in state comprises a cessation of emission of a readable signal by at least one of the first signaling tag or the second signaling tag.

10. The method of claim 1, wherein the change in state comprises emission of a signal having a different frequency than a signal emitted in the first signal state.

11. The method of claim 1, wherein the change in state comprises emission of a signal having a different communication field than a signal emitted in the first signal state.

12. The method of claim 1, wherein the change in state comprises emission of a signal having a different amplitude than a signal emitted in the first signal state.

13. An apparatus for detecting that an object has been accessed, the apparatus comprising at least one processor, wherein the at least one processor is configured to cause the apparatus to at least:

detect a change in state of a signal emitted by at least one of a first signaling tag carried by a first surface or a second signaling tag carried by a second surface, the change in state resulting from the second surface being transitioned from a first position to a second position, wherein the first signaling tag is positioned on the first surface and the second signaling tag is positioned on the second surface such that when the second surface is in the first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag, whereby an antenna of at least one of the first signaling tag or the second signaling tag is at least partially detuned by the coupling, thereby resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag, and wherein when the second surface is transitioned from the first position to the second position, wherein transitioning from the first position to the second position increases the distance between the first signaling tag and the second signaling tag such that a decoupling between the first signaling tag and the second signaling tag results in the antenna of at least one of the first signaling tag or the second signaling tag no longer being at least partially detuned, thereby resulting in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag; and

in response to detecting the change in state, determine that an object associated with at least one of the first signaling tag or the second signaling tag has been accessed.

14. The apparatus of claim 13, wherein the object comprises a receptacle in which a healthcare item is stored, and wherein the at least one processor is further configured to cause the apparatus to determine, in response to detecting the change in state, that the healthcare item has been accessed.

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15. The apparatus of claim 13, wherein the object comprises a receptacle, and wherein the at least one processor is further configured to cause the apparatus to determine, in response to detecting the change in state, one of that an item has been added to the receptacle or that an item has been removed from the receptacle.

16. The apparatus of claim 13, wherein the apparatus is coupled to a tag reader positioned at a station along a conveyor system used to move the object, the tag reader being configured to read a signal emitted by one or more of the first signaling tag or the second signaling tag, and wherein the at least one processor is further configured to cause the apparatus to detect the change in state based at least in part on an indication received from the tag reader.

17. The apparatus of claim 13, wherein the first surface comprises a surface of a receptacle, and wherein the second surface comprises a surface of a closure for the receptacle.

18. A system for facilitating detection of an object being accessed, the system comprising:

a first surface;  
a second surface;  
a first signaling tag carried by the first surface; and  
a second signaling tag carried by the second surface;  
wherein the first signaling tag is positioned on the first surface and the second signaling tag is positioned on the second surface such that when the second surface is in a first position, the first signaling tag and the second signaling tag are sufficiently proximate to each other such that a coupling occurs between the first signaling tag and the second signaling tag, whereby an antenna of at least one of the first signaling tag or the second signaling tag is at least partially detuned by the coupling, thereby resulting in a first signal state being emitted by at least one of the first signaling tag or the second signaling tag; and

wherein when the second surface is transitioned from the first position to a second position, wherein transitioning from the first position to the second position increases the distance between the first signaling tag and the second signaling tag such that a decoupling between the first signaling tag and the second signaling tag results in the antenna of at least one of the first signaling tag or the second signaling tag no longer being at least partially detuned, thereby resulting in a second signal state being emitted by at least one of the first signaling tag or the second signaling tag.

19. The system of claim 18, wherein one or more of the first surface or the second surface comprises a surface of the object.

20. The system of claim 18, wherein the object comprises a receptacle in which a healthcare item is stored.

21. The system of claim 18, wherein the first surface comprises a surface of a receptacle, and wherein the second surface comprises a surface of a closure for the receptacle.

22. The system of claim 18, wherein the second surface comprises a surface of the object, and wherein the first surface comprises a surface on which the object rests when the second surface is in the first position.

23. The system of claim 18, further comprising a tag reader configured to read a signal emitted by one or more of the first signaling tag or the second signaling tag to enable detection of a change in state of a signal emitted by at least one of the first signaling tag or the second signaling tag in an instance in which the second surface is transitioned from the first position to the second position.